

Reptile-Associated Salmonellosis: A Preventable Pediatric Infection

Utpala Bandy MD, MPH, Helen McCarthy, PhD, Christopher Hannafin, DVM

EPIDEMIOLOGY

Salmonellosis, a major cause of diarrheal illness in the United States, causes an estimated 14 million illnesses and 600 deaths annually. There are 2,449 known *Salmonella* serotypes of which approximately 200 are detected in the United States in any given year.¹ Between 1987 and 1997, the rate of reported *Salmonella* infections (average of 40,169 reports per year) decreased from 19 to 13 per 100,000 persons. However, while some serotypes are reported to have decreased in frequency, serotypes associated with reptiles are showing an increase in frequency. The serotypes with the greatest average annual increase in the number of isolates reported from 1987 to 1997 are *Salmonella* Stanley, and *Salmonella* Marina; both serotypes are reptile-associated. Of the top 20 increasing *Salmonella* serotypes, seven, or 35%, are common to reptile-associated *Salmonella* serotypes (Stanley, Marina, Flint, Kintambo, Wassenar, Ealing, Carrau, and Abaetuba). Also, data from the National *Salmonella* Surveillance System, representing 441,863 *Salmonella* isolates from humans from 1987-1999, demonstrate that the rate of overall isolation of *Salmonella* is highest in the New England region; that overall, children have the highest *Salmonella* isolation rate; and that infants have a 4-13 fold higher rate of invasive disease than other age groups.²

In Rhode Island from 1997 to 2001 (Figure 1), the total number of cases of *Salmonella* infections (all ages) decreased from a high of 172 total cases in 1997 to 161 cases reported in 2001. The average number of *Salmonella* cases reported for this period in children younger than 5 years of age is 44, which represents an attack rate four to five times higher than for older children and adults. Of note is the fact that about a third of the cases (range 28.6 to 35.6%) in the under five age group had isolates known to be reptile-associated strains. Since cases are not interviewed, a history of a reptile in the home could not be confirmed. Of the isolates in children under five, there was an average of 2.8 invasive infections (bacteremias) per year (range 0-7). Whether the bacteremia isolates were reptile associated strains or

not is unknown as serotyping blood isolates for *Salmonella* bacteremia was not routinely performed until recently. It needs to be pointed out that the numbers reported here are underestimates and that the actual number of cases is probably significantly higher. Many cases of *Salmonella* illness are not reported, not every ill person seeks medical attention, and health-care providers may not always obtain a specimen for diagnosis.

An estimated 3% of American households own close to 7.3 million reptiles, and the number of reptiles imported into the U.S. has increased dramatically from 27,806 in 1986 to 798,405 in 1993.³ The majority of the imported reptiles are iguanas; snakes and turtles are also included in this category. Approximately 93,000 cases per year of *Salmonella* infections are estimated to be attributable to pet reptile contact.⁴ Reptile-associated *Salmonellosis* is not a new phenomenon. In the early 1970s, pet turtles were responsible for an estimated 280,000 cases of salmonellosis each year. The Centers for Disease Control and Prevention (CDC) estimated that in 1973 pet turtles accounted for 14% of the *Salmonella*-caused illnesses in the United States. In an attempt to control this number of *Salmonella* infections, a ban was enforced on all interstate shipment of pet turtles with shells of 4 inches or less in length. At that time, the

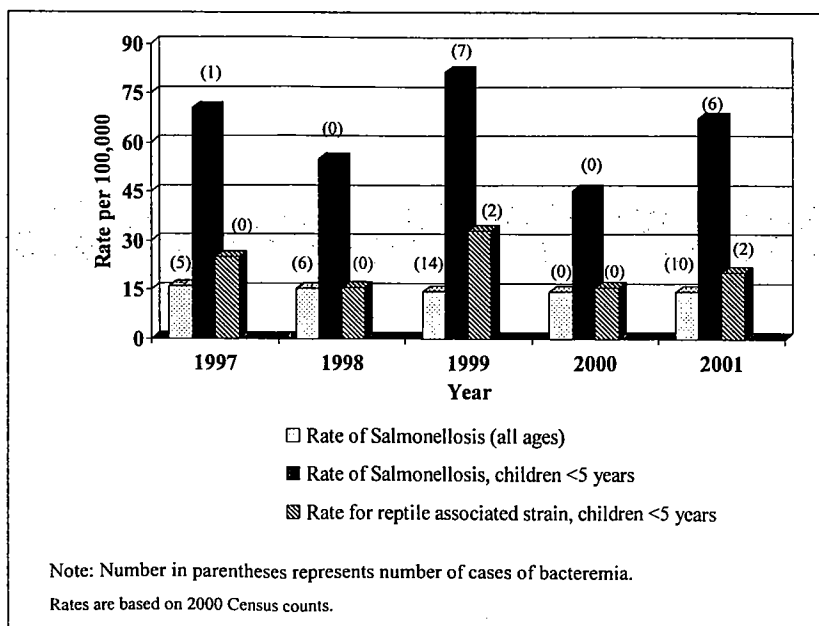


Figure 1.

U.S. Food and Drug Administration (FDA) reasoned that turtles larger than 4 inches did not pose as much of a threat for *Salmonella* infection because children would not likely fit them into their mouths. Since that time, studies have shown that direct contact is not necessary for transmission of *Salmonella* bacteria. Nevertheless, the ban on turtles proved to be very effective, because an estimated 100,000 fewer annual cases of turtle-associated salmonellosis occurred among children following the ban.⁵

TRANSMISSION

The principal habitat of *Salmonella* bacteria is the intestinal tract of humans and animals. *Salmonella* is endemic in reptiles; iguanas have long been known to harbor *Salmonella* bacteria. Because iguanas will not breed if closely confined, most of the pet iguanas sold in the U.S. have either been captured in the wild or have been bred in farming/ranching operations in Central America. Reptiles are infected from before birth, obtaining infection as live newborn or shelled embryos passing through the cloaca of the mother. Being captive bred, incubated and born, is no guarantee that any reptile is *Salmonella*-free; upon entry into the U.S. a large number of these animals (up to 90%) are already asymptomatic carriers of *Salmonella*. High rates of *Salmonella* in the feces of iguanas may be related to the eating of feces by hatchlings, a typical behavior for iguanas, and other vegetarian lizards, that establishes normal intestinal flora for hindgut fermentation. Reptiles can also become infected through contact with other reptiles. Infected reptiles periodically shed *Salmonella* bacteria in their feces. While treating animals with antibiotics may seem a logical first line of defense in preventing transmission, attempts to eliminate *Salmonella* in reptiles (as is true for humans as well) with antibiotics have been unsuccessful and can promote the selection of resistant strains.

Either direct or indirect contact with infected reptiles and their environment can cause human illness.^{4,7} The most common route for human infection is through oral ingestion. Individuals who handle a reptile, or who handle objects contaminated by a reptile, and then fail to wash their hands properly may ingest *Salmonella* bacteria. The exact means of transfer is not always evident and can be subtle. Direct contact with the animal is not necessary for transfer of *Salmonella*. Cases have occurred in children who did not have direct contact with the animal(s) but were infected after visiting another person who owned iguanas or after eating at a house of a person who owned an iguana.⁷ Identification of an uncommon *Salmonella* serotype in a person who has no other apparent exposure should trigger a more extensive investigation into a possible reptile linked exposure. In every case reported by the CDC, the diagnosed *Salmonella* infection was linked to direct or indirect contact with a pet reptile from which the same serotype was isolated. Therefore, a patient with *Salmonella* infection that cannot be traced to an identifiable source may have been exposed to *Salmonella* from a reptile.

CLINICAL ISSUES

The clinical manifestation of reptile-associated *Salmonellosis* is similar to that seen for other types of *Salmonella* infections. *Salmonellosis* manifests as acute enterocolitis, with sudden onset of headache, abdominal pain, diarrhea, nausea and sometimes vomiting. Dehydration, especially among infants may be severe. Bloodstream infections can be life threatening, especially in very young children, the elderly, or in persons with weakened immune systems. Infants younger than 1 year of age are at greatest risk for more severe forms including sepsis and meningitis. Symptoms may appear from 12 to 72 hours after exposure but usually occur within 18 to 36 hours after exposure. The disease is usually self-limiting and lasts from 4 to 10 days. *Salmonella* bacteria can remain in the stool for several days to several weeks after symptoms cease. During this time, infected persons can transmit the infection to others. *Salmonella* infections disproportionately affect infants and young children, especially bottle-fed infants. It is speculated that infant formula may allow for the multiplication of *Salmonella*. Persons who are immune-compromised or elderly, are also at a high risk for *salmonellosis*. Antibiotics given previously to a *Salmonella* infection may also play a role in the severity of the disease. Receiving antibiotics within 30 days before infection may be a risk factor for bacteremia. Antibiotics are suggested to increase susceptibility to *Salmonella* infection by altering colonic flora. Most people with *salmonellosis* will recover without antibiotic treatment. In severe cases, fluids may be needed to prevent dehydration. If *Salmonella* infection involves the blood or other non-intestinal tissues, antibiotic therapy is indicated. Food service workers, day care workers and health care workers should be excluded from work until diarrhea subsides.

PREVENTION

Public education through anticipatory guidance (including at prenatal visits) may be a more promising method of minimizing the risk of salmonellosis than prohibiting the sale of pet reptiles. To this end, a mailing with posters and patient information materials are sent to medical providers and school nurse-teachers. Physicians must be aware of the epidemiological features of *salmonellosis* and must recognize that reptiles carrying *Salmonella* may be the cause of *salmonellosis* and *Salmonella* sepsis. Veterinarians, pet shop owners and herpetological societies should provide educational materials and guidance about salmonellosis to reptile owners. Informing such owners about the correct methods for reptile food preparation, husbandry and handling can lead to cleaner environments and reduced propagation of the bacteria. Reptiles living in healthy environments are less likely to shed *Salmonella* bacteria. The staff in facilities that handle reptiles should follow recommended precautions for reducing the risk of transmission of *Salmonella* from reptiles to humans. Routine screening of reptiles by bacterial culture is unreliable due to the intermittent shedding of the bacteria and therefore discouraged. Prophylactic antibiotic treatment of asymptomatic animals is not recommended and

is not an effective method for prevention. Maintaining and separating reptiles and all the related food, bedding, water, waste and cleaning materials from contact with areas or materials used for humans will significantly reduce the potential for transmission.

RECOMMENDATIONS FOR PREVENTING TRANSMISSION OF *SALMONELLA* FROM REPTILES TO HUMANS

- Pet store owners, veterinarians, and pediatricians should provide information to owners and potential purchasers of reptiles about the risk for acquiring salmonellosis from reptiles.
- Persons should always wash their hands thoroughly with soap and water after handling reptiles or reptile cages.
- Persons at increased risk for infection or serious complications of salmonellosis (e.g., children aged less than 5 years and immunocompromised persons) should avoid contact with reptiles.
- Pet reptiles should be kept out of households where children aged less than 5 years or immunocompromised persons live.
- Families expecting a new child should remove the pet reptile from the home before the infant arrives.
- Pet reptiles should not be kept in child care centers.
- Pet reptiles should not be allowed to roam freely throughout the home or living area.
- Pet reptiles should be kept out of kitchens and other food-preparation areas to prevent contamination. Kitchen sinks should not be used to bathe reptiles or to wash their dishes, cages, or aquariums. If bathtubs are used for these purposes, they should be cleaned thoroughly and disinfected with bleach.

For additional information and access to resource materials visit: www.cdc.gov/healthypets/animals/reptiles.htm, or call the Office of Communicable Diseases at 401 222 2577.

REFERENCES

1. Brenner FW, Villar RG, Angulo PJ, et al. *Salmonella* nomenclature. *J Clin Microbiol* 2000;38:2465-7.
2. Olsen SJ, Bishop R, Brenner FW, et.al. The changing epidemiology of *Salmonella*: trends in serotypes isolated from humans in the United States, 1987-1997. *J Infect Dis* 2001;183:753-61.
3. Lewis C. The fright of the Iguana. *FDA Consumer* 1997;31:33-7.
4. Reptile-Associated *Salmonellosis* - Selected States, 1996-1998. *MMWR* 1999;48:1009-13.
5. Cohen ML, Potter M, Pollard R, Feldman RA. Turtle-associated *salmonellosis* in the United States: Effect of public health action, 1970-1976. *JAMA* 1980;243:247-9.
6. Reptile-Associated *Salmonellosis* - Selected States, 1994-1995. *MMWR* 1995;44:347-50.
7. Mermin J, Hoar B. Iguanas and *Salmonella* Marina infection in children: A reflection of the increasing incidence of reptile-associated *Salmonellosis* in the United States. *Pediatrics* 1997;99:300-402.

Utpala Bandy, MD, MPH, is Assistant Medical Director, Division of Disease Prevention and Control, RI Department of Health, and Rhode Island State Epidemiologist.

Helen McCarthy, PhD, is a Health Policy Analyst, Office of Communicable Diseases at the RI Department of Health.

Christopher Hannafin, DVM, is the State Public Health Veterinarian, RI Department of Environmental Management.



HINES DERMATOLOGY ASSOCIATES, INC.

*BC/BE General Surgeon/
Plastic Surgeon needed for
busy dermatology practice,
full time/part time days.*

*Competitive salary.
Providence, Rhode Island
and/or southeastern
Massachusetts. No J1 VISA
positions available.
Fax CV to 508-226-9619.*

MEDICAL OFFICE CONDOMINIUM FOR SALE

*East Providence
1400 SF
Bay Medical Center*

\$135,000.00

*AUBIN CORP.
508-336-4000 x22*